Biological systems in tree breeding

Joint meeting of IUFRO working parties
S2.04-02 and S2.02-16, in Tuusula, Finland,
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Foreword

Biological Systems in Tree Breeding was the topic of a joint meeting of two IUFRO working parties, S2.04-02, Breeding theory and progeny testing, and S2.02-16, Seed orchards. The indoor sessions were held in Tuusula, Finland, September 10–15, and the adjunct study tour to Central Sweden took place September 16–19. There were 75 participants from 22 countries during the Finnish part of the meeting. Unfortunately, not all of them were able to join the nice voyage and study tour, and so during the latter part we were only 38 visitors.

The aim of the meeting was to strongly point out that tree breeding, among many other things, has reached an obligatory check point. General goal of tree breeding used to be "to solve a special problem or to produce a specially desired product" (Zobel and Talbert 1984). Conventionally the main method has been selection for the relevant phenotypic character. The theory has rather exclusively been based on quantitative genetics and biometry. Rapid development of computers has allowed application of more and more complex formulae and extensive empirical data. The sophisticated statistical models cannot be more than black-box models! A profound understanding of the biological mechanisms would certainly improve many efforts belonging to genetic improvement. Significant progress has been made in the field of biological research, especially in physiology, molecular biology, and biotechnology.

The undeniable change of the global environment as well as the public attitude to pollution and biodiversity must not be neglected, when breeding strategies and mass propagation methods are to be planned.

The work of the actual meeting was organized into four main sessions. For each session one keynote speaker had been deliberately chosen. The main sessions and speakers were:

1. Biological systems in tree breeding, Gösta Eriksson
2. Biomass production and allocation in trees, Don Dickmann
3. Vegetative propagation and biotechnology, Hely Häggman
4. Sexual reproduction, Władysław Chatupka

In addition, 10 other papers and 16 posters were presented. Tore Skröppa and Hans Roulund acted as observers during the meeting. Their summary of the main points is given below. All papers that arrived in due time, and that were accepted in the normal referee inspection of the journal are published in this special issue of Silva Fennica.

On behalf of the organizing committee I have the pleasure to thank all participants and our technical staff. Last but not least we are indebted to our sponsors:

- The Academy of Finland
- The Ministry of Agriculture and Forestry
- The Society of Forestry in Finland
- The Central Association of Finnish Forest Industries
- Finnish Forestry Association
- Kemira
- Hanksija Plant Breeding Institute
- Lännen Tehtaat

Their economical support made it possible to invite several researchers, and allowed all of us hospitality and some extra comfort.

Veikko Koski

Summary of main topics and conclusions from the meeting

Hans Roulund & Tore Skröppa

This report summarizes main topics from presentations and conclusions from the discussions. Major points are stated by numbers and are followed by some explanations.

1. More basic research is needed in forest genetics, tree physiology and silvicultural methods.

Large uncertainties exist concerning the future forest environment. The forests will be utilized by the society in a number of different ways, and a multi-purpose forestry is called for. This requires flexibility in forest management and to change goals. The scientists should provide both the forestry and the society in general with answers for a wide array of future potential situations. Forest genetics should cover a much wider field than research for tree breeding only and should also address other species than those that are commercially utilized.

2. A better understanding of the components that constitute complex traits is necessary.

This relates both to the genetic variation of the processes behind complex characters and a better physiological understanding. It will be important to obtain reliable estimates of the genetic relationships between different traits or groups of traits and utilize this information in breeding.

3. Breeding for wide adaptability should be a major concern.

A main reason for this is all uncertainties concerning the future forest environment and the multiple uses of the forest. More research is needed on how the adaptability of a population relates to its level of genetic variability.

4. Research in plant physiology is an important complement to forest genetics.

Tree physiology should be an integrated part of forest tree breeding. Physiologists and geneticists should work together in joint research units to obtain a better cooperation. Important topics are: flowering physiology, description of key factors in site adaptability, nutrient use efficiency, drought tolerance, frost tolerance and ageing.

Flowering, in particular, is a topic that requires more attention by both physiologists and geneticists. More information is needed about the mechanisms that regulate flowering and about potential physiological and genetic effects of flowering manipulations.

5. The reproduction system in the present open-pollinated seed orchards is unpredictable and does not match advanced breeding methods.

Research is needed on reproduction systems that can more efficiently capture the potential gains of bred material. A warning: Genetic material should not be selected to match the reproduction system used.

6. Physiological tests can generally not replace field experiments, but should complement these.

Screening methods should be developed for physiological test criteria that are reliable predictors of field performance.

7. Long-term field trials with genetically diverse material may be important in the future.

Some of the old trials should therefore be kept and managed. Of particular importance are trials that are planted in large plots.

8. The ideotype approach is interesting but still immature for practical applications.

Morphological and physiological components need to be investigated by means of modeling and experimental studies. Silvicultural and economical systems must also be taken into consideration.

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